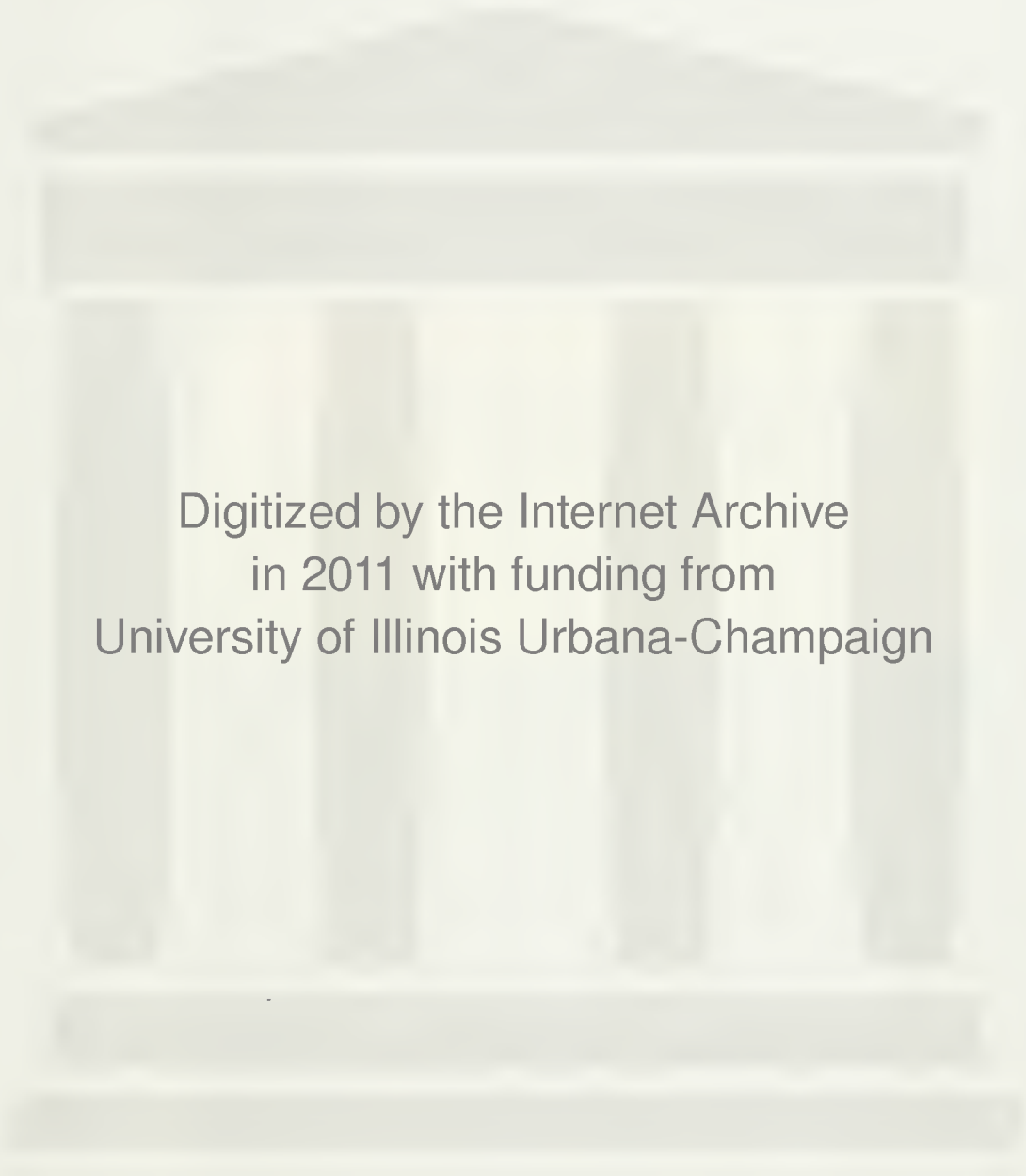

Faculty Working Papers

# A PRAGMATIC VIEW ON EDUCATION IN INFORMATION SYSTEMS DEVELOPMENT

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College of Commerce and Business Administration
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## ABSTRACT

Concerned groups and individuals have urged the development of educational programs in information systems development in view of the growing shortage of qualified systems analysts. One of the serious problems facing the nation's universities is the shortage of pragmatic information useful for developing such a program and the difficulty of finding qualified personnel to staff it. Since systems analysis is a professional field evolved from the experience accumulated in industry, its current practice needs to be critically examined before designing the program. For this purpose, we asked officials in charge of systems development activity at various organizations to evaluate the usefulness of academic subjects, directly and indirectly related to the activity, in pursuing their careers. This paper reports the summary result of evaluations made by 50 respondents representing 45 organizations.

## KEY WORDS AND PHRASES

education, management systems, systems analysis, management information systems, information systems development, information analysis, system design

## INTRODUCTION

In recent years, concerned groups and individuals have urged the development of educational programs in information systems development in order to meet the growing shortage of qualified systems analysts. In this connection, especially noteworthy are the reports submitted by the ACM Curriculum Committee on Computer Education for Management.[1,2] In these reports, the Committee described detailed outlines of major new courses necessary for a professional program in systems development and recommended new fields of specialization in existing programs.

The exact magnitude of the shortage of systems analysts is unknown, but we may obtain some idea of it from data available in published studies. According to Gilchrist and Weber,[3] the total number of 1970 graduates with a Bachelor's or Master's degree in systems analysis was 423, while the same totals in data processing and computer science were 379 and 1,593, respectively. They estimated the numbers of 1971 graduates from computer-related programs in higher education were 3,350 with a BA/BS, 2,070 with a MA/MS, and 335 with a Ph.D. Of these graduates, they estimated only 2,300 with a BA/BS, 1,400 with a MA/MS, and 110 with a Ph.D. would enter the labor force. In summary, a total of 5,755 would graduate from computer-related programs in higher education in 1971, but only 3,810 of them would enter the labor force. The authors could not break down the entrants into job skills because of inadequate data, but projected most of these entrants would become systems analysts. In another report,[4] the same authors estimated that the total numbers of systems analysts and computer programmers employed in the U.S. in 1970 were 150,000 and 210,000, respectively; and that in 1971, the number

of systems analysts would increase by about 18% or 27,000, while the number of programmers by about 13% or 27,300. This means that even if all of the 3,810 graduates from computer-related programs in higher education were to become systems analysts, they could fill less than 15% of the new openings in 1971.

Facing this great shortage, why are the nation's universities so slow to develop educational programs to train systems analysts? It is suspected that many universities are not even aware of the need for such programs. Universities being aware of the need are often unable to develop a program owing to internal or external restrictions. One serious restriction imposed on them is the shortage of pragmatic information useful for developing a program, and another is the difficulty of obtaining qualified people to staff the program.

Systems analysis as a profession has evolved through the experience of industry accumulated over the past two decades. Its present practice needs to be carefully studied and fully understood before designing an educational program, particularly if a pragmatic program is to be developed. To obtain information on the present practice, therefore, we conducted an attitude measurement study in the spring of 1972. We sent questionnaires to various organizations and asked their officials in charge of systems analysis activity to evaluate the usefulness of some 50 topics in pursuing their careers. The following sections describe an outline of the study, the organizations and respondents covered, and the result.

## STUDY ON THE USEFULNESS OF TOPICS

### An outline of the study

The purpose of the study was to gain pragmatic information regarding the suitability of 52 topics listed in Table I as subjects to be included in a graduate program in systems development offered by a school of business. The respondent was asked to evaluate the usefulness of these topics from the standpoints of providing the student with both technical skills required and administrative backgrounds necessary for a successful career. Further, he was asked to make this evaluation by taking into consideration the current practice and expected near-future developments in systems analysis.

The topics listed in the questionnaire were intended to cover areas directly and indirectly related to systems analysis. They were obtained from the following sources: (1) books on computer concepts and applications; (2) the announcements of professional seminars in systems analysis and related fields; (3) the descriptions of courses included in educational programs in management informations systems offered by various schools of business The questionnaire excluded such topics as accounting, finance, marketing, organization, and production that are usually included among the courses required for the student at the business school. It was impossible to select the titles of topics in such a way that their information contents were uniform in quantity and depth and free from duplication. When a topic represented part of a larger area covered by another topic, the former meant an investigation of the subject matter more in depth than the latter.

The study was conducted in two steps: the first step was a preliminary survey covering 10 respondents representing 10 organizations, and the second step was the main survey covering 40 respondents representing 35 organizations. Several respondents of the preliminary survey suggested new relevant topics to be added to those listed in the questionnaire. Consequently, these new topics were included in the questionnaire used in the main survey.

Organizations and respondents covered

The study covered 45 organizations composed of the following types and numbers: state government (1 office), newspaper publishing (1 firm), consulting (6 firms), banking (7 firms), insurance (2 firms), public utility (6 firms), transportation (2 firms), retail chain (3 firms), chemical and oil production (3 firms), steel and cast-iron production (2 firms), manufacturing (11 firms), and conglomerate (1 firm). Of the organizations studied, 8 organizations, including the state government, newspaper publisher, and 6 consulting firms, did not make their financial statements publicly available. The remaining 37 organizations could be classified into the following groups according to their gross sales in 1970: less than $100 million (5 firms), $100-500 million (14 firms), $500 million-$1 billion (5 firms), $1-2 billion (7 firms), $2-3 billion (3 firms), and over $3 billion (3 firms).

The responding organization was asked to have the questionnaire evaluated by its top-ranking specialist in systems analysis. Though the job titles of the respondents were diverse, even for a similar functional position, they indicated the organizational positions of the

system analysis function and degrees of importance placed on this function in respective organizations. The breakdown of the respondents by job title was as follows:

| | | |
|---|---|---|
| Vice-President | - | 8 respondents |
| Director | - | 10 respondents |
| Controller | - | 1 respondent |
| Manager | - | 15 respondents |
| Chief | - | 1 respondent |
| Supervisor | - | 5 respondents |
| Various Staff Specialist Titles | - | 5 respondents |
| Partner | - | 5 respondents |
| Total | - | 50 respondents |

Of the 8 vice-presidents, four headed divisions specialized in the functions of information processing and systems analysis, while the remaining four headed business divisions named Controller, Finance, Business Administration, and General Administration Divisions, and managed the two functions as part of the larger responsibilities. Of the 32 respondents with managerial titles such as director, manager, supervisor, and chief, twenty-two supervised only the systems analysis function, whereas the remaining ten supervised both the information processing and systems analysis functions. Though the names of the units managed by these respondents varied, the following names appeared more than once: Data Processing, Computer Systems, Information Systems, Systems, and Systems Development. The five partners representing management consulting and public accounting firms headed groups named Management (Advisory or Consulting) Services or Administrative Services that included computer systems development as one of the main consulting services.

The result of the study

The respondent evaluated the usefulness of each topic by selecting one of the following scores: 1 (not useful), 2 (slightly useful), 3 (useful), 4 (very useful), and 5 (essential). From the results of the two surveys, the frequency distribution of respondents by usefulness score and the weighted average score have been obtained and listed in Table 1. In this table, topics are grouped under the following four major categories: (1) System Development, (2) Data Processing Management, (3) Computer Hardware and Software, and (4) Computer Applications and Processing Methods. Within each categorical group, topics are sequenced in the descending order of the average score. Topics included in the two surveys had a maximum of 50 respondents, whereas topics included only in the main survey a maximum of 40 respondents.

Of the 52 topics evaluated, only eleven received average scores in the first quarter of the scale (very useful - essential), twenty one in the second quarter (useful - very useful), eighteen in the third quarter (slightly useful - useful), and two in the fourth quarter (not useful - slightly useful).

Significant points in each group are now discussed. In the Systems Development Group, Management Systems Analysis was rated as essential by 90% of the respondents, receiving the highest score in the entire list. Seven topics, following Management Systems Analysis in Table 1, received average scores in the interval very useful - essential. They were Data Base Design, File Organization, Planning and Control of Systems Projects, Analysis of Information Requirements, Organization Structure and Information Systems, Human Relations

in Systems Development, and Field Projects in Systems Development. All these topics, except for Field Projects, may be considered sub-topics of Management Systems Analysis. Most respondents considered, the field project would be very useful for the students if it was properly selected and guided by industry. Seminars in Management Systems and Human Factors in Information Processing were given average scores in the interval useful - very useful. Over one half of the respondents rated the former as very useful or essential and suggested a series of lectures by knowledgeable guests from business, industry and government.

In the Data Processing Management Group, Economics of Computer Configuration and Use was rated highest, being the only topic that received an average score in the interval very useful - essential. The topic rated second was Computer Auditing, getting an average score just below very useful. Several respondents considered this topic very important for the systems analyst and suggested the course on computer auditing to include audit trails, controls, and contingency plans. Other topics receiving average scores in the interval useful - very useful were Computers and Software Security, Software Package Analysis ('Buy' or 'Make'), Computer Scheduling and Control, and Computer Center Organization and Management. Respondents considered these topics would be very necessary for the student to enhance his managerial effectiveness.

In the Computer Hardware and Software Group, Introduction to Computer Concepts and Data Processing was the only topic receiving an average score in the interval very useful - essential. Following Management Systems Analysis, it was rated second highest among all the

topics. Respondents commonly remarked that a well-designed course on Introduction to Computer Concepts and Data Processing, also covering the rest of the topics in the group, was the extentent of knowledge on computer hardware and software required for the normal practice in systems analysis. Data Management Systems received an average score just below very useful, but many respondents thought only brief knowledge about commercially available data management packages would be adequate for the student.

Computer languages and programming are important subjects in computer education. However, the level of programming skill necessary for a business student is an unsettled matter. In the preliminary survey, we included a topic named Skill in Computer Programming, but all 10 respondents rated it as not useful or slightly useful. As a result, this topic was dropped from the questionnaire of the main survey. As to Familiarity with Programming Languages, COBOL received the highest average score, just below very useful, with 70% of the respondents scoring it as essential or very useful. FORTRAN was rated second, receiving an average score in the interval useful - very useful, but much below the score for COBOL. The remaining topics of the group were related to computer systems and networks, peripheral devices, and operating systems. In regard to these topics, the respondents considered information beyond the introductory level unnecessary and gave average scores in the neighborhood of useful.

In the Computer Applications and Processing Methods Group, the top ranking topic was Computer Simulation that received

an average score in the middle of the interval useful - very useful. This popular academic subject has yet to show its usefulness in systems development work in industry. The remaining topics in this group, mostly research oriented subjects in computer science, got little support of the respondents, receiving average scores lower than useful.

In the Quantitative Methods Group, Introduction to Statistics was the only topic with an average score in the interval very useful - essential. Respondents emphasized, however, its application rather than its mathematics. The second ranking topic was Introduction to Operations Research, receiving an average score a little below very useful. Again, its application was emphasized by respondents. All remaining topics in the group were given average scores much lower than those of the two preceding topics and in the neighborhood of useful. In general, respondents were not enthusiastic about the use of mathematical tools, indicating the very limited use of these tools in the present practice.

## SUMMARY

In this study, 50 systems analysts at 45 organizations evaluated the usefulness of each of 52 topics for systems development work by selecting one of the following scores: 1 (not useful), 2 (slightly useful), 3 (useful), 4 (very useful), and 5 (essential). The summary result of their evaluations indicates that some topics are clearly useful in the present practice, while others are not. But the usefulness of many of the remaining topics, mostly receiving average scores in the interval useful - very useful, is inconclusive because of the relatively small sample size.

The findings of the study depicted, in a sense, a pragmatic view expressed by the respondents as a group on the educational program in systems development to be offered by the school of business. Among them, more important ones are as follows:

1. Management Systems Analysis, including those sub-topics listed in the Systems Development Group in Table I, is the most important subject for the student in the program.
2. A comprehensive course on Introduction to Computer Concepts and Data Processing is the extent of knowledge necessary for him regarding computer hardware, software, networks, and peripheral devices.
3. With regard to computer languages and programming, he is advised to be familiar with COBOL, but does not need a skill in programming.
4. Computer Auditing is an important subject and should cover audit trails, controls, and contingency plans on backup, recovery, and reconstruction.
5. Introductory courses on Statistics and Operations Research are highly recommendable to the student if they emphasize applications rather than mathematics.
6. Economic Evaluation of Computer Configuration and Use and other topics listed in the Data Processing Management Group are very necessary for the student to enhance his managerial effectiveness.

REFERENCES

1 Education related to the use of computers in organization

A Position Paper of the ACM Curriculum Committee on Computer Education for Management Communications of the ACM New York New York Vol 14 No 9 pp 573-588 September 1971

2 Curriculum recommendations for graduate professional programs in information systems

A Report of the ACM Curriculum Committee on Computer Education for Management Communications of the ACM New York New York Vol 15 No 5 pp 363-398 May 1972

3 B GILCHRIST R E WEBER

Sources of trained computer personnel -- A quantitative survey

Proceedings of 1972 SJCC American Federation of Information Processing Societies Inc Montvale New Jersey

4 B GILCHRIST R E WEBER

Employment of trained computer personnel -- A quantitative survey

Proceedings of 1972 SJCC American Federation of Information Processing Societies Inc Montvale New Jersey

Table 1. Usefulness of Topics: Average Scores and Frequency Distributions of Respondents

| Topic | Average Score | Number (Percentage) of Respondents Scoring: Essential 5 | Very useful 4 | Useful 3 | Slightly useful 2 | Not useful 1 | Total Number of Respondents |
|---|---|---|---|---|---|---|---|
| 1. System Development | | | | | | | |
| Management Systems Analysis | 4.88 | 45(90%) | 4( 8%) | 1( 2%) | 0( 0%) | 0( 0%) | 50 |
| Data Base Design | 4.45 | 27(55%) | 17(35%) | 5(10%) | 0( 0%) | 0( 0%) | 49 |
| File Organization | 4.42 | 26(53%) | 13(27%) | 6(12%) | 4( 8%) | 0( 0%) | 49 |
| Planning and Control of System Projects | 4.42 | 29(58%) | 13(26%) | 8(16%) | 0( 0%) | 0( 0%) | 50 |
| Analysis of Information Requirements | 4.40 | 28(56%) | 14(28%) | 8(16%) | 0( 0%) | 0( 0%) | 50 |
| Organizational Structure and Information Systems | 4.13 | 16(42%) | 12(32%) | 9(24%) | 1( 2%) | 0( 0%) | 38 |
| Field Projects in Information Systems Analysis | 4.02 | 20(40%) | 15(30%) | 12(24%) | 2( 4%) | 1( 2%) | 50 |
| Human Relations in System Development | 4.00 | 19(39%) | 16(33%) | 10(20%) | 3( 6%) | 1( 2%) | 49 |
| Seminar in Management Systems | 3.67 | 11(23%) | 16(33%) | 16(33%) | 5(11%) | 0( 0%) | 48 |
| Human Factors in Information Processing | 3.25 | 6(12%) | 13(27%) | 18(38%) | 9(19%) | 2( 4%) | 48 |
| Human Factors in Equipment Design and Work Layout | 2.75 | 5(12%) | 4(10%) | 12(30%) | 14(36%) | 5(10%) | 40 |

Table I. continued (2 of 5)

| Topic | Average Score | Number (Percentage) of Respondents Scoring: Essential 5 | Very useful 4 | Useful 3 | Slightly useful 2 | Not useful 1 | Total Number of Respondents |
|---|---|---|---|---|---|---|---|
| 2. Data Processing Management | | | | | | | |
| Economics of Computer Configuration and Use | 4.02 | 12(29%) | 21(50%) | 7(18%) | 2( 5%) | 0( 0%) | 42 |
| Computer Auditing | 3.86 | 14(28%) | 20(40%) | 12(24%) | 3( 6%) | 1( 2%) | 50 |
| Computer and Software Security | 3.38 | 7(18%) | 10(26%) | 14(36%) | 7(18%) | 1( 2%) | 39 |
| Software Package Analysis -- 'Make' or 'Buy' | 3.25 | 5(13%) | 10(25%) | 16(40%) | 8(20%) | 1( 2%) | 40 |
| Computer Scheduling and Control | 3.15 | 2( 5%) | 12(30%) | 18(45%) | 6(15%) | 2( 5%) | 40 |
| Computer Center Organization and Management | 3.15 | 3( 7%) | 12(31%) | 13(34%) | 10(26%) | 1( 2%) | 39 |
| Legal Aspects of Computer Use and Software | 2.69 | 3( 6%) | 8(16%) | 13(27%) | 21(43%) | 4( 8%) | 49 |
| Computers and Society | 2.42 | 1( 2%) | 8(17%) | 8(17%) | 24(50%) | 7(14%) | 48 |
| 3. Computer Hardware and Software | | | | | | | |
| Introduction to Computer Concepts and Data Processing | 4.76 | 40(80%) | 8(16%) | 2( 4%) | 0( 0%) | 0( 0%) | 50 |
| Familiarity with Programming Languages: | | | | | | | |
| COBOL | 3.92 | 16(32%) | 19(38%) | 10(20%) | 5(10%) | 0( 0%) | 50 |
| FORTRAN | 3.10 | 2( 4%) | 15(31%) | 20(41%) | 10(20%) | 2( 4%) | 49 |

Table I. continued (3 of 5)

| Topic | Average Score | Number (Percentage) of Respondents Scoring: Essential 5 | Very useful 4 | Useful 3 | Slightly useful 2 | Not useful 1 | Total Number of Respondents |
|---|---|---|---|---|---|---|---|
| Job Control Language | 2.83 | 7(15%) | 6(12%) | 13(28%) | 14(30%) | 7(15%) | 47 |
| Assembler Language | 2.65 | 3( 6%) | 8(16%) | 14(29%) | 17(35%) | 7(14%) | 49 |
| BASIC | 2.46 | 1( 2%) | 6(12%) | 18(38%) | 12(25%) | 11(23%) | 43 |
| PL/I | 2.38 | 2( 4%) | 4( 8%) | 18(38%) | 10(21%) | 14(29%) | 48 |
| Martime Language | 1.79 | 0( 0%) | 3( 6%) | 6(13%) | 17(35%) | 22(46%) | 48 |
| Data Management Systems | 3.98 | 13(27%) | 26(54%) | 4( 8%) | 5(11%) | 0( 0%) | 48 |
| Time Sharing and Real-Time Systems | 3.37 | 6(12%) | 18(37%) | 14(29%) | 10(20%) | 1( 2%) | 49 |
| Teleprocessing Devices | 3.14 | 5(10%) | 15(31%) | 14(29%) | 12(24%) | 3( 6%) | 49 |
| Teleprocessing Network Organization | 3.08 | 0( 0%) | 14(36%) | 15(38%) | 9(23%) | 1( 3%) | 39 |
| Operating Systems | 3.00 | 2( 4%) | 12(24%) | 21(44%) | 12(24%) | 2( 4%) | 49 |
| Input/Output Devices | 2.90 | 4( 8%) | 8(16%) | 18(37%) | 17(35%) | 2( 4%) | 49 |
| Magnetic Disk- and Tape-Storage Devices | 2.82 | 5(10%) | 6(12%) | 17(35%) | 17(35%) | 4( 8%) | 49 |
| **4. Computer Applications and Processing Methods** | | | | | | | |
| Computer Simulation | 3.44 | 7 (14%) | 12(24%) | 27(54%) | 4( 8%) | 0( 0%) | 50 |

Table I. continued (4 of 5)

| Topic | Average Score | Number (Percentage) of Respondents Scoring: Essential 5 | Very useful 4 | Useful 3 | Slightly useful 2 | Not useful 1 | Total Number of Respondents |
|---|---|---|---|---|---|---|---|
| Information Retrieval Theory | 2.71 | 1( 2%) | 9(19%) | 19(10%) | 13(27%) | 6(12%) | 48 |
| Studies on Man-Machine Interactive Decision Making | 2.65 | 3( 6%) | 7(14%) | 15(31%) | 18(37%) | 6(12%) | 49 |
| Artificial Intelligence or Automatic Problem Saving by Computer | 2.11 | 0( 0%) | 4( 9%) | 8(17%) | 24(51%) | 11(23%) | 49 |
| List Processing | 2.10 | 0( 0%) | 2( 5%) | 9(23%) | 19(49%) | 9(23%) | 39 |
| Sorting and Merging Methods | 1.88 | 0( 0%) | 2( 4%) | 7(14%) | 23(47%) | 17(35%) | 49 |
| 5. Quantitative Methods | | | | | | | |
| Introduction to Statistics | 4.04 | 17(34%) | 19(38%) | 13(26%) | 1( 2%) | 0( 0%) | 50 |
| Introduction to Operations Research | 3.76 | 11(22%) | 18(36%) | 19(38%) | 2( 4%) | 0( 0%) | 50 |
| Linear Programming | 3.27 | 7(14%) | 12(24%) | 17(35%) | 13(27%) | 0( 0%) | 49 |
| Statistical Sampling Theory | 3.27 | 8(16%) | 10(21%) | 18(38%) | 11(23%) | 1( 2%) | 48 |
| Statistical Regression Analysis | 3.23 | 8(16%) | 9(19%) | 19(40%) | 10(21%) | 2( 4%) | 48 |
| Adaptive and Heuristic Methods | 3.16 | 7(14%) | 9(18%) | 21(42%) | 11(22%) | 2( 4%) | 50 |
| Statistical Decision Theory | 3.13 | 5(10%) | 11(23%) | 17(36%) | 15(31%) | 0( 0%) | 48 |

Table I. continued (5 of 5)

| Topic | Average Score | Number (Percentage) of Respondents Scoring: Essential 5 | Very useful 4 | Useful 3 | Slightly useful 2 | Not useful 1 | Total Number of Respondents |
|---|---|---|---|---|---|---|---|
| Queueing Theory | 2.97 | 4(10%) | 7(18%) | 13(33%) | 14(36%) | 1( 3%) | 39 |
| Stochastic Processes | 2.73 | 3( 6%) | 6(13%) | 17(35%) | 19(40%) | 3( 6%) | 48 |
| Non-Linear Programming | 2.71 | 2( 4%) | 7(15%) | 16(33%) | 21(44%) | 2( 4%) | 48 |
| Numerical Analysis and Error Estimation | 2.65 | 0( 0%) | 9(19%) | 16(33%) | 20(42%) | 3( 6%) | 48 |
| Dynamic Programming | 2.63 | 4( 8%) | 5(10%) | 13(28%) | 21(49%) | 5(10%) | 48 |